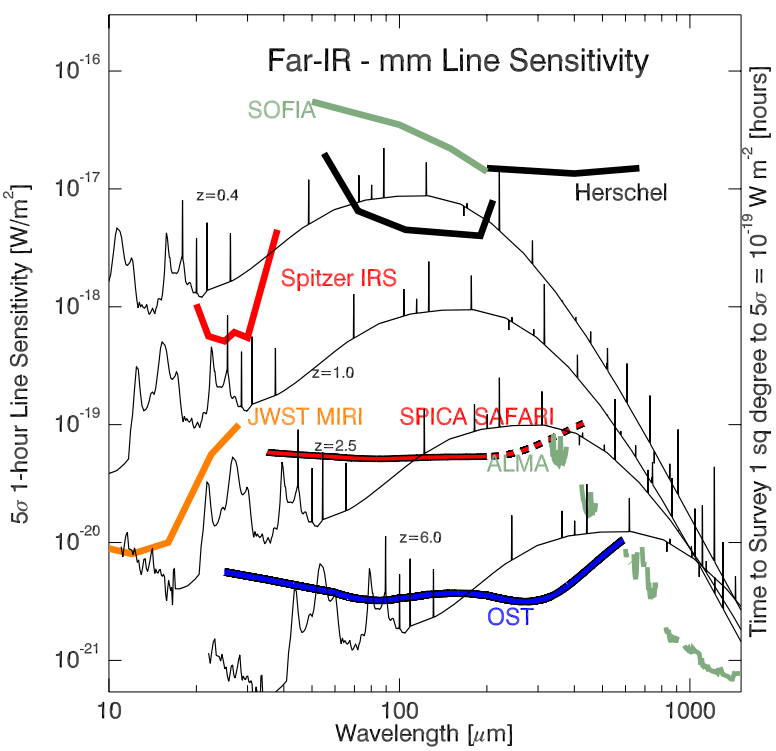
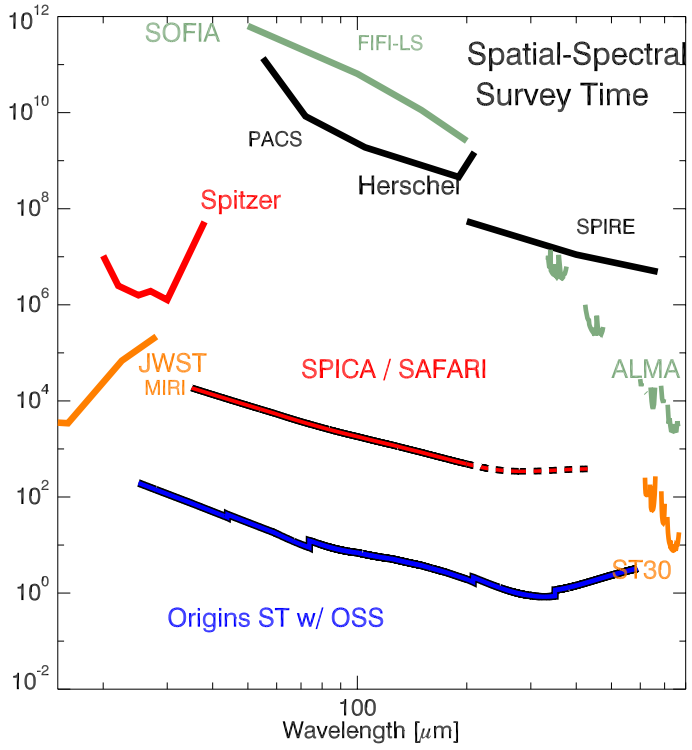
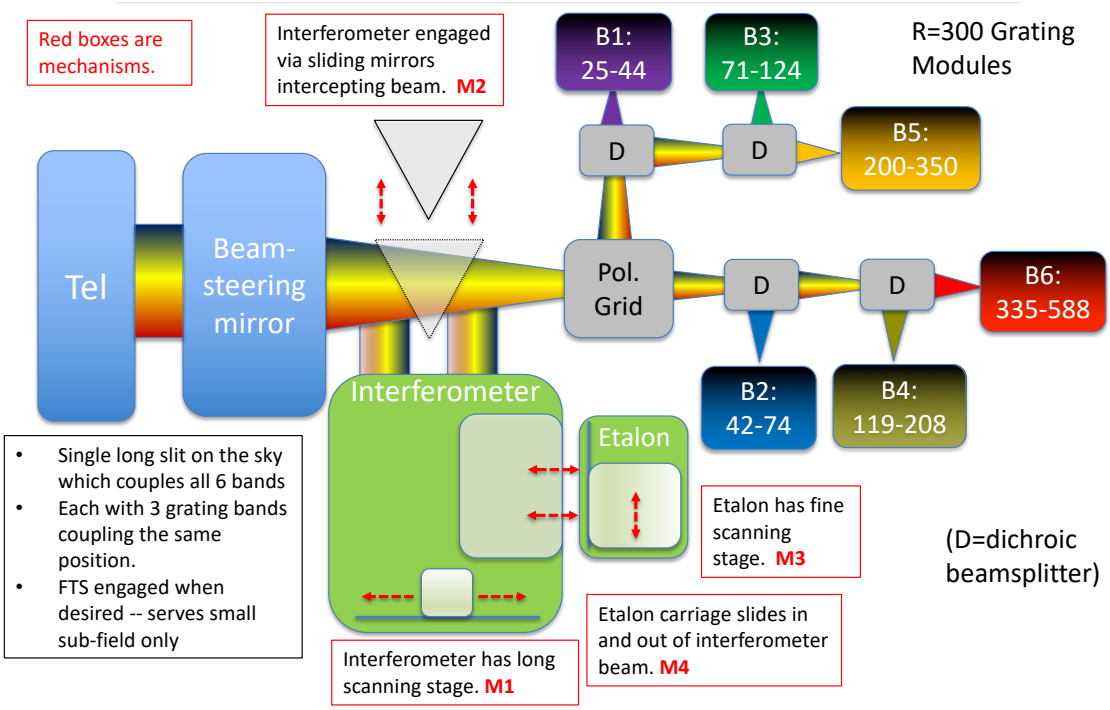
Origins Survey Spectrometer (OSS) -- Fact Sheet updated October 15, 2018

Suite of six R=300 gratings covers 25-590 µm with large throughput.

- Long slits with ~35-100 beams per slit. Serves point sources and mapping.
- Sensitivity limited by photon noise from zodiacal light, telescope. Real-world factors included.
- Assumes 5.9m telescope: 3e-21 W m^{-2} (5σ, 1 h) at 100 microns, includes chopping along slit.
- Single overlapping slit on the sky, so full-band spectrum of a single source can be obtained simultaneously.
- **No source confusion for spectroscopy.** Universe is naturally measured in 3 dimensions.
- Exquisite surface brightness sensitivity for faint ISM probes in Milky Way and nearby galaxies.







- 6 grating modules spaced logarithmically with overlapping slits.
- Each a bolted aluminum structure (no moving parts).
- Each has a 50 mK detector array with 6k-16k detectors
- Polarizing grid and dichroics are lightweight, passive elements.
- 2 high-res modes engaged in a small sub-field for all bands (next page)

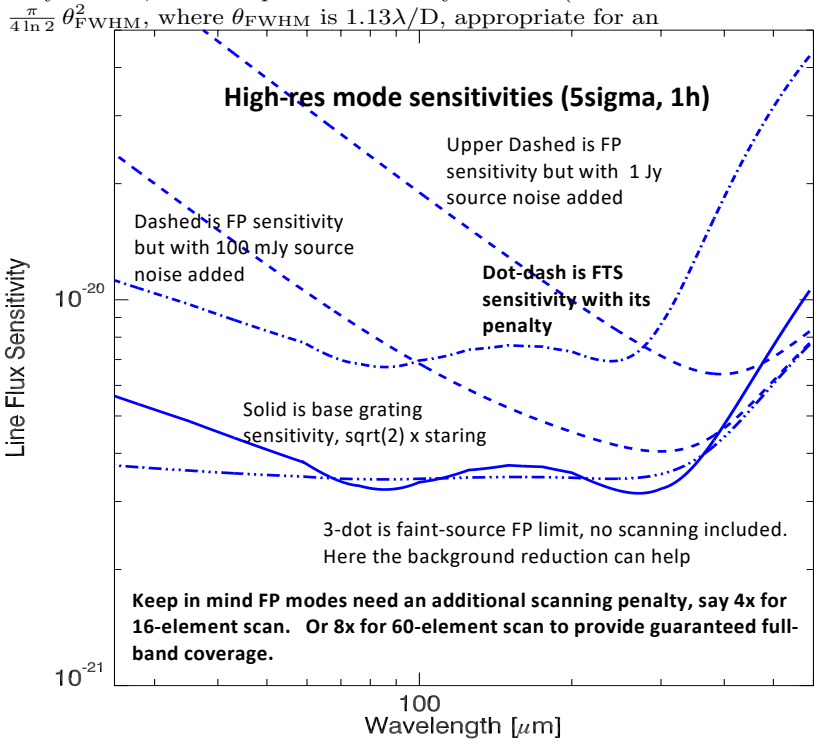
Table 1. OSS R=300 Grating Backends (on OST Concept 2 5.9-m telescope)

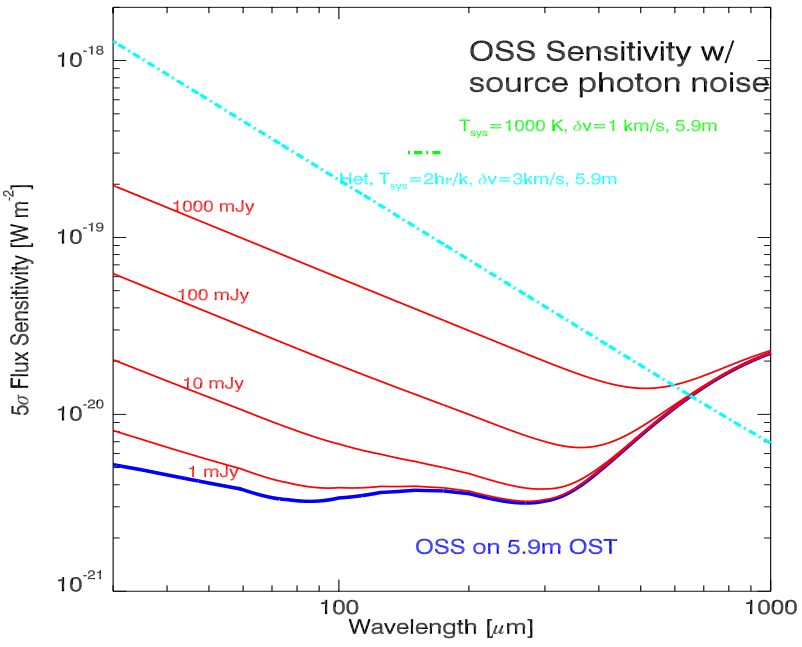
Parameter	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6	$D_{\rm tel}$ sclg
λ [μm]	25–44	42–74	71–124	119–208	200–350	336–589	
Beam size [arcsec]	1.41	2.38	4.0	6.7	11.3	19.0	$\propto D^{-1}$
Slit length [arcmin]	2.7	4.0	4.7	7.9	10.7	13.6	$\propto D^{-1}$
Instantaneous FOV [sq deg]	1.43e-5	3.5e-5	7.2e-5	2.0e-4	4.6e-4	9.7e-4	$\propto D^{-2}$
Array size [mm], spectral × spatial	67×78	67×57	67×62	210×115	210×141	255×127	
Array format spectral × spatial	168×95	168×83	168×60	168×60	168×48	140×36	
Pixel pitch [mm], spectral × spatial	0.40×0.81	0.40×0.69	0.40×1.0	1.25×1.9	1.25×2.9	1.5×3.5	
Per-beam sensitivities — includes $\sqrt{2}\times$ penalty for chopping / modulation (w/ OST FSM)							
Point source line sens [W m^{-2}, 5σ, 1h]	5.0e-21	3.9e-21	3.3e-21	3.7e-21	3.2e-21	5.9e-21	$\propto D^{-2}$
Line surf bright sens [W m^{-2} sr^{-1}, 5σ, 1h]	1.7e-10	4.7e-11	1.4e-11	5.6e-12	1.7e-12	1.0e-12	$\propto D^{0}$
Point source R=4 cont. sens [μJy, 5σ, 1h]	2.5	3.2	4.6	8.7	12.	39.	$\propto D^{-2}$
Point source mapping speeds — here perfect background subtraction is assumed							
Map. spd [deg^2/(10^{-19}W m^{-2})^2/sec]	3.2e-6	1.3e-5	3.7e-5	8.2e-5	2.6e-4	1.5e-4	$\propto D^{2}$
Map. spd [deg^2/[μJy]^2/sec]	1.3e-9	1.9e-9	1.9e-9	1.5e-9	1.6e-9	3.5e-10	$\propto D^{2}$
Pt. sce map depth, given field, given time	see example tables below						$\propto D^{-1}$
Intensity mapping sensitivity (noise. equiv. intensity / sqrt($N_{\rm beams}$))							
NEI /$\sqrt{N_{\rm modes}}$ [MJy/sr/$\sqrt{\rm sec}$], 1σ	0.57	0.29	0.17	0.11	0.063	0.075	$\propto D^{0}$

Numbers are for a 5.9-meter telescope, they can be scaled per the last column, under the assumption that the number of pixels (the optical AΩ or étendu) is fixed. Notes: Sensitivities assume single-polarization instruments with a product of cold transmission and detector efficiency of 0.25, and an aperture efficiency of 0.72. (Field of view is based on number of beams and a solid angle of $\frac{\pi}{4\ln 2}\,\theta^2_{\rm FWHM}$, where $\theta_{\rm FWHM}$ is 1.13λ/D, appropriate for an assumed 10dB edge taper.)

High-res modes provide full high-res spectrum in all bands simultaneously in small field (1 beam at highest R values)

1. **Fourier-Transform Spectrometer (FTS).** Engages front-end for a small portion of the grating slit field. Uses same grating backends for full band coverage and high sensitivity.
   - 2.4 m of optical path difference with 8x path folding on 30 cm stage – **R= 43,000 x [112 µm / λ].**
   - Sensitivity penalty relative to grating only ~2x in W/m².
2. **Additional very high resolution mode uses Fabry-Perot (FP aka etalon) together with FTS. R=325,000 x [112 µm / λ] out to 300 microns.**





Sensitivity Degradation due to source photon noise.

- Few to tens of mJy sources have small impact on sensitivity.
- Brighter sources also have brighter lines.

Line-to-continuum important as well.

- e.g. HD 112 microns; Klaus expects line to continuum of 0.1 x 11 km/s. High-res mode has 7 km/s so contrast of 13% or so – should be detectable.
- For brighter lines, e.g. in ISM mapping mode, could perhaps detect in native R=300 mode, then line-to-continuum sets calibration accuracy requirement.
- E.g. water: 2x contrast at 10 km/s 2% contrast at R=300 (1000 km/s).